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New Technique for Optimal Smoothing of Data

A new recursive method for the optimal smoothing of data has been developed. The results of numerical studies show that this method is superior to the older methods in those cases when smoothing gives an estimate which is significantly better than that which can be obtained using optimum filtering techniques. In addition to this numerical superiority, the new smoothing scheme is more easily understood in terms of physical reasoning than the earlier methods.

A derived smoothability condition enables the user to determine under what circumstances smoothing yields an estimate which differs from a backward extrapolation of the final forward filter estimate. If he determines that part or all of the state is nonsmoothable, the user can realize a saving in computer time by using backward extrapolation of the final forward filter state estimate to obtain the smoothed estimate of these quantities.

A recursive method for starting a Kalman filter (Note 1) when no a priori information is available is presented in the study. Recursion formulas, called a cofilter, are used in the new smoother formulation. Also based on the cofilter, a method is described for performing partial state estimation when there is insufficient information to completely determine the state.

The new smoothing technique was applied to a nonlinear parameter identification problem. The results obtained from this study, which was organized as a simulation, show that optimum smoothing is a useful technique in those nonlinear situations where linearization about a reference solution is valid.

Notes:

1. The Kalman filter is a time-domain solution of differential equations describing the time variation of quantities being measured. The Kalman filter is valid for nonstationary statistics and time varying systems. It gives the transient as well as the steady-state solution.
2. Complete details may be obtained from:
Technology Utilization Officer
Manned Spacecraft Center
Houston, Texas 77058
Reference: B68-10060

Patent status:

No patent action is contemplated by NASA.

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